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"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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(Continued on page facing back cover)

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TABLE OF CONTENTS

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A HISTORY OF THE ESTABLISHMENT OF THE RING-NECKED PHEASANT IN CALIFORNIA[1]

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Introduction

Surprisingly, many persons living in California are under the impression that the ring-necked pheasant is a native bird. It is easily understood for this princely gamebird has been present within the boundaries of the State longer than the earliest memory of the majority of the population. Its presence dates back more than a half century although there was no legalized hunting until 1933 in most parts of the State. It is the purpose of this paper to attempt to trace the history and development of the ring-necked pheasant population in California. This present study is a part of a general investigation into the life history and management of the ring-necked pheasant in California.[2]

Information concerning early attempts at pheasant acclimatization was obtained from the Biennial Reports of the California Fish and Game Commission and those of its parent body, the State Board of Fish Commissioners. Later data was procured from copies of the quarterly California Fish and Game, from records of the Hayward State Game Farm (no longer existent) and from those of the present state game farms.

Grateful appreciation is extended to Mrs. Hilda Grinnell for the use of the bibliography begun by the late Dr. Joseph Grinnell and kept current by her, to Miss Susan Chattin for the use of files of literature and publications in the library of the Museum of Vertebrate Zoology, and to Mr. Howard Twining, leader of the present pheasant project, for valuable suggestions and helpful criticism in the preparation of the manuscript. Thanks are also due present and past Fish and Game personnel who have given much helpful information.

Early Liberations

The earliest state liberations of pheasants occurred in 1889 when, because of the success which Oregon experienced in acclimatizing pheasants, Mr. W. H. Shebley was sent by the State Board of Fish Commissioners to Oregon to procure ring-necked pheasants from farmers and from others breeding the birds. He obtained about 140 birds, at $10 a pair, which were released in Monterey, Sacramento, Marin, and Nevada Counties, and in some localities in the San Joaquin Valley.

However, private liberations had already been made of English pheasants, a strain developed by centuries of hybridization between the Chinese ring-necked pheasant *(Phasianus colchicus torquatus)* and the black neck pheasant *(Phasianus colchicus colchicus)*. According to Belding (1890) a liberation was made in the woods of Santa Cruz County

[1] Submitted for publication September, 1946.
[2] Federal Aid in Wildlife Restoration, Project California 22-R, The life history and management of the ring-necked pheasant in California.

but nothing has been seen or heard of them since. This liberation must have been made in the late 1870's or in the early 1880's for the information was based upon a report dated October 12, 1885, by Mr. Ramon E. Wilson of the California Sportsman's Association, in which he dates it "Some years ago * * *."

English pheasants were released at San Mateo at very nearly the same time and, although a flock of 22 was subsequently seen, the experiment was not considered a success. The Country Club of Marin County introduced English pheasants prior to 1889 but the birds soon disappeared. As frequently was the case with early attempts, glowing reports of success were made immediately following the liberation. A period of silence ensued to be followed by the dour admission that no trace of the liberation remained.

In 1891 the State Legislature passed an act protecting introduced game birds for a period of four years; a violation of the act would be constituted a misdemeanor.

In the spring of 1894 Mongolian pheasant *(Phasianus colchicus mongolicus)* were obtained and 67 were distributed by the State Board of Fish Commissioners to private aviaries in various counties where it was believed the birds would do well. The plan was to liberate all birds produced from this parent stock upon public grounds. After the flush of excitement had subsided it was admitted that the experiment had not been altogether successful. A few birds were released but the locations were not noted. In addition to this indirect method an unknown number of pheasants were imported and released in different sections of the State in 1895 or 1896, notably in Santa Clara, Kern, and Tehama Counties by the State Board of Fish Commissioners.

In the fall of 1897 an agent was again sent to Oregon to purchase Mongolian pheasants. Three hundred twenty-three were purchased and released in five-pair lots in almost every section of the State. Reports from almost every shipment reported that "nides of young birds have been seen during the past season * * *."

During this same period, according to the Biennial Report for 1899-1900, 93 Mongolian and 150 English ring-necked pheasants were purchased and liberated subsequent to September 1, 1898. The Mongolian pheasants were imported from Hong Kong at a cost of 75 cents per bird while the English pheasants were procured in Oregon, cost unknown. Reports of success were all of a negative nature with the exception that "nides of young birds have been seen in Humboldt, Santa Clara, and Fresno Counties." Ultimate success of the liberations was then considered doubtful except in the moist regions of the State. One wonders whether that author lived to see the successful pheasant populations in the Sacramento Valley during rice cultivation.

The next Biennial Report spoke optimistically of increases in pheasant populations, with Santa Clara County probably at the head of the list. It was reported that pheasants numbered about one thousand on the Morrow Ranch near San Jose, Santa Clara County. Favorable reports also came from Fresno, Humboldt and Santa Cruz Counties, with occasional occurrences noted in Santa Barbara and San Luis Obispo Counties. The author of this report felt that these counties offered the best game warden protection for the birds and that this was solely responsible for the increase.

The succeeding report again handed the bouquet to Santa Clara County, followed by favorable reports from Fresno, Humboldt, Santa Cruz, and Kern Counties. By 1905-06 the price of imported ring-necked pheasants had risen to a point that the Commission decided it would be more economically sound to encourage private individuals to raise pheasants than to purchase them for liberation. No further state liberations were made until after the inception of the first state game farm.

The Hayward State Game Farm

With the desire for ring-necked pheasants in California, a state game farm was authorized in 1908. Mr. J. R. Argabrite, a successful raiser of pheasants in Ventura County, was engaged as superintendent. F. W. Van Sicklen, a member of the State Fish and Game Commission, was instrumental in establishing this program. The choice of a site finally fell upon some 45 acres located one mile west of Hayward, Alameda County. The pheasant breeding stock came from various sources: Oregon and California breeders and from Wenz and Mackensen of Yardley, Pennsylvania, importers of European stock.

Of the twelve hundred young pheasants raised during the first season, about eight hundred were distributed to the "best" sections of the State. Siskiyou, Humboldt, and Inyo Counties received the largest numbers, ranging from 75 to 80 birds in each liberation. Twenty counties received pheasants from the Hayward State Game Farm during the first year of its operation.

TABLE 1

Ring-necked Pheasant Liberations, Hayward State Game Farm
1909-1918, Inclusive

Year	*Number liberated*	*Year*	*Number liberated*
1909	573	1915	591
1910	94	1916	95
1911	112	1917	58
1912	1,355	1918	164
1913	1,141		
1914	--	Total	4,183

TABLE 2

Estimate of 1916 Ring-necked Pheasant Population

Locality	*County*	*Number*
Williams	Colusa	200-300
Eureka	Humboldt	700-800
Fortuna	Humboldt	500
Big Pine	Inyo	1,000
Cloverdale	Lake	500
Susanville	Lassen	100
Snelling	Merced	150
Pacific Grove	Monterey	200
Napa	Napa	300-500
Grass Valley	Nevada	100-200
Milpitas and Coyote	Santa Clara	2,000
Watsonville	Santa Cruz	Several hundred
Lodi	San Joaquin	75-100
Fort Jones	Siskiyou	75-100
Greenview	Siskiyou	Several hundred
Yreka	Siskiyou	200
Porterville and Lindsay	Tulare	Several hundred
Total Estimated 1916 Population		6,900-8,150

FIGURE 1. Ring-necked pheasant liberations from the Hayward State Game Farm, 1909 through 1918, inclusive. Figures are the numbers liberated within each county.

This auspicious beginning was followed by a succession of happenings which tended to remove the aura of success being ascribed to the game farm. Vandalism included the opening of pens allowing the birds to escape and the scattering of poisoned wheat in the remaining pens.

In 1911 Mr. William N. Dirks was engaged as superintendent of the Hayward State Game Farm. Through his far-sightedness in retaining records of all game farm transactions and through his cooperation by furnishing information for the preparation of this manuscript, it has

been possible to determine the numbers and general locations of pheasant liberations. These records are now in the Fish and Game Library, located in the Ferry Building, San Francisco. Thirteen hundred fifty five pheasants were liberated in 1912. According to Grinnell, Bryant, and Storer (1918) the total number of pheasants liberated by the Fish and Game Commission up to 1916 was approximately five thousand. Table 1 lists the total annual liberations of pheasants from the Hayward State Game Farm while Figure 1 indicates in which counties the liberations were made and the numbers involved.

In 1916 Fish and Game Commission deputies made estimates of the then existing pheasant populations. These estimates are presented as Table 2.

After fifty pheasants had been liberated near Coyote Lake, Santa Clara County, encouraging reports were received in 1901 from this locality, according to Grinnell, Bryant, and Storer (1918). The Commission had previously issued encouraging reports for this county as early as 1900 and had placed it at the head of the list in 1902. By 1916 pheasants were well scattered over the Santa Clara Valley, especially in the Alviso-Milpitas area, north of San Jose.

Mr. J. S. Hunter reported seeing two broods of young and several adults on the Forgeus Ranch near Williams, Colusa County, in June, 1916. This was the first published report of success for a region that was destined to provide some of the best pheasant shooting in the State.

In the Biennial Report of the Fish and Game Commission for the period 1914-15, decision for the abandonment of the game farm was announced. It was believed that sufficient attempts had been made to stock the State with ring-necked pheasants. During the 10 years of its operation the Hayward State Game Farm raised for liberation 4,183 pheasants. Many of these were shipped by express and although no record of subsequent losses were kept, the actual number of birds liberated was probably less.

Limited though its facilities and output were, liberations had been made in at least 31 of the 58 counties. Some of these liberations were successful and formed established nuclei for later large populations. It is known that sites in Santa Clara, Santa Cruz, and Inyo Counties have supported limited pheasant populations from the time of early releases, possibly to the carrying capacity of the particular habitat. As the entire State is surveyed, probably other original successful sites will be discovered.

Pheasant Establishment

About the time of the termination of the Hayward Game Farm, there were indications that pheasants were becoming numerous in certain areas. Seven ranches in Santa Clara County reported destruction of nests by mowers. Crop damage by pheasants was reported from Owens Valley with a request that there be either an open season on pheasants or that they be entirely unprotected. Reliable observers reported that pheasants were especially numerous in this area between 1924 and 1926 before the inception of the present state game farms system and their mass liberations.

In a letter to Dr. Joseph Grinnell dated December 9, 1920, Mr. W. A. Strong wrote in part " * * * in regard to the ring-necked pheasant I

find that they are pretty well established around Milpitas and April 24th, Mr. D. B. Bull took me to a nest containing 16 eggs far advanced in incubation * * *. The orchardist informed us of several nests that were destroyed by the mowing machines * * *. A few days later, upon another trip I noted three more ring-necks, near Alviso, on the same road. The last few days I read in the papers of hunters killing three more and paying one hundred dollars fine each * * *."

In 1921 Mr. Charles Follett of Merced wrote that "* * * as many as 50 or 60 birds could be seen in morning flocks in the vicinity of Antioch." He further stated that teen-aged boys would " * * * bring barley sacks as full of pheasants as they could get them and some in their coats * * * to be sold to restaurants of Isleton, Rio Vista, Ryde, Walnut Grove, Locke and Courtland."

The Inter-Game Farm Period

Demand for liberation of additional pheasants became strong in the 1920's so the Fish and Game Commission contracted with Mr. E. H. Lewis, a private breeder, to furnish five thousand ring-necked pheasants. Inyo County received three thousand five hundred of these in 1925 in the vicinity of Lone Pine, Independence, Bishop, and Round Valley. This information was furnished by Mr. Carl J. Walters, deputy at Independence at the time, who made the liberations with Mr. Lewis. Eight ranches in San Diego County received one thousand three hundred birds and two hundred fifty more, augmented by fifty purchased by the local sportsmen, were released in the Modesto area.

That pheasants had increased phenomenally in Inyo County is indicated by the opening of a pheasant season during 1925. The area included Inyo and Mono Counties (District 4½). Hunting was permitted from December 1-7 with a limit of six birds per season. The pheasant population was heavily hunted and the season was not reopened the following year. At this same time the pheasants were being deprived of suitable habitat by the drying up of Owens Valley. This was accomplished by the Los Angeles Water System which operated a series of wells and reservoirs feeding the Los Angeles aqueduct.

The Present State Game Farms

Plans for a state game farm in Napa County were already under way by this time and Mr. August Bade, who was experienced in raising game birds in the State of Washington, was chosen superintendent. Construction was begun in 1925 and pheasants were liberated in the following year. During the first year of its operation the Yountville State Game Farm liberated 3,032 pheasants, 75 percent as many as were liberated by the Hayward State Game Farm in its 10 years of operation. Production increased at an accelerated rate until 1942 when 43,740 rink-necked pheasants were liberated. In the following few years, because of the influence of World War II, production dropped. During the first 20 years of its operation, the Yountville State Game Farm, the Los Serranos State Game Farm (established near Chino in 1929), and subsidiary game farms, jointly liberated at least 309,428 pheasants. This figure was derived from signed receipts for birds and from game farm reports. However, it is felt that the loss of receipts and the liberation of birds from state-distributed eggs would undoubtedly swell the total to 325,000

FIGURE 2. Ring-necked pheasant liberations from state game farms, 1926 through 1945, inclusive. Figures are the numbers liberated within each county. Records are incomplete for Inyo and Kern Counties.

or more. Every county in the State, with the exception of Alpine County, has received state-reared pheasants. Table 3 lists the annual liberations from the present state game farms from 1926 to 1945, inclusive, while Fig. 2 depicts the additional numbers of ring-necked pheasants released during this same period and in which counties they were released.

Hunter and Fry (1941) record the six leading pheasant counties as being Butte, Glenn, Sacramento, Yolo, Colusa, and Sutter, based upon

estimates derived from questionnaires filled out by hunters. None of these counties were considered possessing good pheasant habitat during early attempts at pheasant acclimatization. Santa Clara County which once held the lead in estimated pheasant numbers, is not mentioned among the leading pheasant counties. The reasons for this change are quite apparent and are primarily the result of changes in agricultural practices. Clean cultivation became pronounced in Santa Clara County in the early 1920's while the opposite condition appeared during World War I in the Sacramento Valley with the introduction of rice culture. Coupled with this change in agricultural practice is the preponderance of small farms and ranches in Santa Clara County while most of the holdings in the Sacramento Valley are large. Generally this latter condition means less disturbance to the resident pheasant population.

The question naturally arises as to whether the rink-necked pheasants are actually established to the point where they can maintain their population or if the birds that are shot are the ones which are liberated in such large numbers. According to Hunter and Fry (1941), the estimated pheasant kill for the six leading pheasant counties shows that a total of 185,700 pheasants were taken during the four-year period of 1935 through 1938. During the same period, 11,151 pheasants were liberated in these counties, or 6 percent of the kill. This precludes that all the liberated birds actually reached the hunter's bag. According to Tubbs (1946) the percentage of return of banded, liberated birds to the hunter's bag during a current year averaged between 1.3 and 9.0 percent, depending upon the time of the year the birds were released. It was also determined that the return to the hunter's bag of banded liberated birds for a period of six years averaged 5.5 percent. If we were to apply this finding to the above, 996 of each 1,000 birds bagged would be birds which had been raised in the wild. While this percentage may conceivably be different in California, it should illustrate that pheasants are here to stay, barring changes in agricultural practices which would be detrimental to pheasant habitat.

TABLE 3

Ring-necked Pheasant Liberations; Present State Game Farms 1926-1945, Inclusive

Year	*Number liberated*	*Year*	*Number liberated*
1926	3,023	1937	3,700*
1927	6,362	1938	24,300
1928	6,697	1939	24,086
1929	6,648	1940	25,370
1930	7,211	1941	35,919*
1931	11,434	1942	43,740
1932	6,651	1943	22,468
1933	7,246	1944	20,336
1934	10,646	1945	29,821
1935	4,456		
1936	9,314	Total	309,428

* Liberations data for these years incomplete and unavailable.

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VITAMIN A REQUIREMENTS IN GAME BIRDS[1]

By R. B. Nestler and R. Stow
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Vitamin A holds a very important place in the diet of game birds. In fact, it is absolutely essential for their survival and reproduction. This fact has been established by recent studies conducted at Patuxent Research Refuge to determine the bobwhite quail's vitamin A requirements for breeding, growth and maintenance.

Three generations of pen-reared birds, totaling 2,244 quail, were used in the experiments, and the research was conducted in such a manner that the effect of a deficiency in the first generation could be traced through the third generation. A complete summary of data with a discussion of its significance and importance to both pen-reared and wild quail, was presented at the Eleventh North American Wildlife Conference, and will be found in the Transactions of that Conference, published by the American Wildlife Institute, Washington, D. C.

Requirements of Breeders

Survival of the breeders, their production and hatch of eggs, and the survival of their offspring to 10 weeks of age, increased in direct proportion with the increased quantity of vitamin A in the diet from zero to 8,000 I.U. per lb. of feed, whether from fish oil, pure vitamin A, or carotene. The optimum level of this nutrient for reproduction, and the livability of the offspring was at 6,000 I.U. per lb. of feed. Regardless of the growth diet, only 30 percent of the offspring survived from parents on 3,000 I.U., 49 percent from those on 4,000 I.U., and 54 percent from those on 6,000 I.U.

In fact, the effect of the parents' diet on the offspring was apparent even during the latters' own breeding season a year later. Storage of vitamin A in the livers was also in direct proportion to the level of vitamin A in the diet, but carotene was not stored as efficiently as true vitamin A.

During the winter following the first breeding season, when vitamin A was removed for four weeks from the maintenance diet of the first generation of birds, survival again was in direct proportion to the quantity of the nutrient that had been in the production diet. Only 14 percent of the quail that had been on 2,000 I.U. of vitamin A during the summer survived, in comparison to 92 percent of those on 8,000 I.U.

[1] This article is reprinted from *Feedstuffs* of July 20, 1946, a trade publication of the feed manufacturing industry, under the title "Game Birds Need More Vitamin A." This reprint is published here in order to make this information more readily available to the operators of game farms on the Pacific Coast.—Ed.

[2] The authors express appreciation to H. Bastrom, Bureau of Animal Industry, D. Metzler, United States Fish and Wildlife Service, and William Brew, Manager of the Organic Laboratory of the Ralston Purina Co., for their valuable assistance.

Requirements of Growing Stock

Chicks without access to vitamin A, although from parents that received a high level, were all dead from avitaminosis within three weeks after hatching. Both survival and growth increased in direct proportion with the increase of the vitamin A content of the growth diet, until they reached a maximum at the 3,000 I.U. level. Survival during the winter, regardless of the level of vitamin A in the maintenance diet, was in direct relationship with the level of vitamin A in the growth diet.

When vitamin A was removed from the winter diet, the average number of days that the birds survived increased in direct proportion with the vitamin A in the growth diet, from only 13 days for those that had received as low as 500 I.U., to 50 days for quail that had received 10 times that quantity, or 5,000 I.U. Death from avitaminosis struck only six days after the removal of the vitamin, and claimed 93 percent of the birds before the end of four weeks.

The incorporation of a small quantity of the vitamin A (only 500 I.U.) into the maintenance diet, delayed the onset of mortality to some extent, and kept 68 percent of the birds alive during the first four weeks. Practically no storage of vitamin A occurred in the livers until the quantity of the nutrient in the feed exceeded 2,000 I.U. per lb; then it increased heavily in direct proportion as the potency of vitamin A in the feed rose from 2,000 to 5,000 I.U. Birds from parents on low levels of the nutrient stored less than did those from parents on high levels. Storage of vitamin A from carotene, even at a level of 5,000 units per lb of feed, was poor.

Winter Requirements of Birds

One thousand units of vitamin A per lb of maintenance diet gave optimum survival during winter, and kept the birds in good condition, but was insufficient for subsequent egg production. Optimum production during the following spring and summer occurred among quail that had received 2,500 or more units of vitamin A in the winter diet. Likewise no appreciable quantity of vitamin A was stored until the level of the vitamin A in the diet exceeded 2,500 I.U. per lb. This fact indicates that, despite appearances, the body's requirements for maintenance were not met by 1,000 I.U. per lb of feed. The level of vitamin A in the growth diet affected the storage of vitamin A from the maintenance diet, a low potency during the growing season prevented maximum storage during winter. Again the storage of carotene, as compared to that of the equivalent level of true vitamin A, was very poor.

Low Vitamin Storage

During the past six years the senior author has had several experiences with avitaminosis A in game birds fed commercial diets from reputable manufacturers. Very poor hatchability of eggs and weak watery eyes of young stock, often with subsequent complete blindness, were the prevailing symptoms. Respiratory troubles, developing under seemingly optimum brooding and housing conditions, have caused trouble on many game farms.

In an endeavor to determine how closely the vitamin A potency of diets used generally might approach the optimum quantity required by quail, samples of feed and representative bobwhite (two of each sex from each state) were obtained for vitamin assay this spring from the state game farms of four prominent eastern game-propagating states. The feeds were assayed for both carotene and true vitamin A, either by spectrophotometry combined with chromatography, or by the antimony trichloride method in the cases of most of the tests for true vitamin A. The livers of the representative quail were assayed by spectrophotometric methods.

Table 1 accompanying this article, shows the storage of Vitamin A in the game farm quail as compared with that of experimental quail on fixed levels of vitamin A, or of wild quail.

With the exception of one bird of each sex from State Game Farm 3, the birds from the game farms showed poor storage of vitamin A, especially in comparison with wild stock. The spectrophotometric curves for the absorption of light by the samples with less than 36 I.U. per gram of liver were definitely abnormal, a situation which indicates that the lower figures are not significant and probably represent mostly extraneous material. It is evident that the birds were not receiving enough vitamin A in their diet to permit them to build up a reserve.

Unless such birds when liberated in the wild could find, accept and utilize sources of vitamin A or carotene immediately after being given their freedom, their chances of survival would be slim. There is an excellent possibility that uncomplicated avitaminosis would not be the direct cause of mortality. Rather, vitamin A deficiency would undermine the quail's physical condition so that destruction could occur more readily from predation, adverse weather conditions, or disease. Even marginal or submarginal intakes of vitamin A, or its precursor carotene, while often sufficient to prevent death from avitaminosis, lowers the birds' vitality and alertness, affects their eyesight, and in other ways debilitates them.

In northern climes, when the ground and herbage is covered with ice and snow for extended periods, such birds with a meager or no reserve of vitamin A would be helpless. Feeding stations would be of little value unless the grain supplied consisted primarily of yellow corn, inasmuch as white corn, wheat and other commercial cereals contain little or no carotene.

Commercial Diets Deficient

An analysis of the diets used on the aforementioned state game farms, established the fact that all the commercial mashes involved failed to contain enough true vitamin A at the time samples were taken for assay, to meet the optimum requirements of the game birds. As shown in Table 2, two commercial feeds had only a trace of true Vitamin A, and none of the commercial diets supplied enough total vitamin A to allow for storage by the quail. For optimum reproduction all mashes studied fell far short of meeting the requirements. Only the noncommercial state game mash used at Game Farm 2 showed a satisfactory potency of vitamin A. Unfortunately, in being fed, the latter was combined with two parts of grain and two parts of the commercial mash, so that the resulting vitamin content of the final diet was low.

The Problem of Storage

One very important unknown factor that undoubtedly has influenced the vitamin A content of the diets used at the state game farms was that of length and method of storage since the feed was mixed at the mill. In Ewing's Handbook of Poultry Nutrition, Sections 270 and 301, considerable attention is given to the destruction of carotene and true vitamin A in storage. Ewing makes the thought-provoking statement that "various investigators have found from 25 to 50 percent loss (of vitamin A) in feedstuffs stored in bins, bales and sacks during a few months' time." In fact, there is a good possibility that the source of vitamin A used at the time of incorporation into the diet, was also less potent in this factor than when it was first processed.

Unfortunately, most sources of true vitamin A are not kept under conditions that would hold the loss of potency at a minimum. For the sake of economy, oil is purchased in bulk form, which condition permits regular exposure to oxidation, perhaps over a long period. Often it is not refrigerated. There are times when the oil may become rancid, a condition that probably would accelerate destruction of vitamin A in ordinary room temperature.

It is assumed that storage loss is the answer to the low vitamin A values found in Table 2. One reputable firm stated on its label "Vitamin A and D feeding oil, fortified, .125 percent." Such a level should have furnished over 1,700 I.U. of true vitamin A per lb of the mash. Nevertheless, only a trace was found in the sample. Again, at State Game Farm 1, the superintendent endeavored to supply sufficient vitamin A to his stock by mixing 3 percent of standard codliver oil with the grains, which should have supplied 10,000 I.U. of the nutrient to each pound of feed. However, after six weeks in the feed room and three weeks in a freezing unit awaiting analysis, the grain mixture showed less than 1,900 I.U. of vitamin A.

Recommendations

Ewing in his aforementioned handbook gives as the startling title of Section 273 this statement: "Vitamin A deficiency quite common." Says this poultry authority: "Vitamin A deficiency among poultry seems to be quite common in almost all sections of the country. Since chicks are started almost entirely on commercial feeds, it is highly important to see that these starting feeds are adequate as to vitamin A potency. In most cases poultry receive nothing but the feed as it comes from the bag." A serious message! Especially serious is this matter when the diet consists of commercial feed diluted with grain containing only carotene, which is not utilized as efficiently as true vitamin A, and is possibly present in much lower quantities than is found in the mashes.

Now that wartime emergency restrictions on the use of vitamin A-containing oils have been removed, feed manufacturers should incorporate enough of true vitamin A in their mashes not only to meet the maximum requirements for growth and reproduction of the particular species and age of stock to which it is to be fed, but also enough to meet normal storage losses, and to build up a reserve in the creatures' bodies. This last mentioned consideration is especially vital in the case of game

birds being reared for restocking purposes. A lack of vitamin A reserve in such birds may mean a total loss after liberation of the stock, of all the time, effort, and thousands of dollars being expended by public and private propagators in such an enterprise.

In addition to properly fortifying their feeds with fresh oil of known potency, it is recommended that the feed manufacturers date each sack of feed, and state the approximate true vitamin A and total vitamin A (true vitamin A plus carotene) at the time of mixing. Some food processors date their product; why not the millers?

One step more might be taken. The tag on each sack could state the approximate total vitamin A content, estimated at the end of two months, four months, and six months, when the feed is stored at room temperature or 70° F.

While the writers' immediate concern is with game birds, nevertheless we feel that the problem presented in this article is of vital concern to all stock for which feed is manufactured commercially. Such recommendations as given above, we believe, would prove to be very desirable throughout the entire feed industry. The manufacturer would be better safeguarded, than he is at the present, for there would be less chance of his feed being condemned as deficient in vitamin A, when the trouble lies in long and/or poor storage at the jobber's warehouse, the country store, or the propagator's barn. At the same time the stock raiser would have a better knowledge of what he is feeding, and the quantity he can safely buy on any one occasion.

TABLE 1

Storage of Vitamin A in Quail Livers

Sources of Quail		I.U. of vitamin A per gram — Males	Females	Not Sexed
State Game Farm 1		Trace (both)	Trace (both)	
State Game Farm 2		Trace (both)	Trace; 36	
State Game Farm 3		50; 170	Trace; 200	
State Game Farm 4		Trace (both)	Trace (both)	
From the wild*:	Maryland	290	190; 430	
	Virginia	150; 450	90; 640	
	Pennsylvania	----	90; 350	
	Alabama	70; 760	160; 450	
Patuxent Research Refuge:				
On maintenance diet containing†:				
2,000 I.U. of vitamin A per lb				Trace (both)
3,000 I.U. of vitamin A per lb				110; 220
4,000 I.U. of vitamin A per lb				270; 460
5,000 I.U. of vitamin A per lb.				470; 940

* The extreme cases tested for each sex are shown.

† Each figure is based on the combined livers of two birds. The first figure for each diet represents birds on a low level of Vitamin A in the growth diet; the second figure, birds on a high level in the growth diet. All birds are young stock; the storage in old breeders was proportionately lower.

TABLE 2

Vitamin Potency of Diets Used on Four State Game Farms

State Game Farm	Feed	Vitamin A content (I.U. per lb) — True vitamin A	Carotene	Total vitamin A
1	Commercial D	1,450	860	2,310
	Grains plus 3% fish oil	1,890	770	2,660
2	Commercial B	Trace	840	1,000
	State Game Bird Mash C	3,540	2,650	6,190
	Mixture of mashes and grains	700	760	1,460
3	Commercial A	1,320	1,335	2,655
	Grain mixture	----	650	650
4	Commercial E	Trace	640	700
	Grain mixture	----	810	810

CALIFORNIA SEA LION CENSUS FOR 1946[1]

By Bureau of Marine Fisheries
California Division of Fish and Game

To many people the interesting animals seen on the rocks off our California coast are known as seals. Most of these mammals, however, are not seals but sea lions. Sea lions can be distinguished from the true seal by the presence of an external ear, and by the hind flippers which turn forward when the animal is out of the water. In the true seals the hind flippers are connected by a membrane which prevents such a forward position. The sea lion has a larger and more supple neck than the seal and has neither hair nor claws on its front flippers. There are two kinds of sea lions along the California coast—the Steller, *Eumetopias jubata*, and the California, *Zalophus californianus*. The Steller is larger and lighter in color than the California sea lion. Steller sea lions occur from Alaska southward to the islands off Southern California; and California sea lions from Pt. Reyes southward into Mexican waters. Thus the ranges of the two species overlap in Central California.

Found also in California waters, but in small numbers, is the harbor seal, *Phoca richardii geronimensis*. This is a true seal, and a member of the group known as hair seals. Occasional specimens of the elephant seal, *Mirounga angustirostris*, are observed on the Southern California islands. Until fully protected, the elephant seals were so persistently hunted for their hides and blubber that they became almost extinct. The largest known herd is on Guadalupe Island off the Mexican coast.

Sea lions in former years have also experienced heavy exploitation for their hides and blubber, and as dog food. In addition, at one time many bulls were slaughtered for their trimmings. These consist of the genitalia and gall bladder which were sold to the Chinese for the manufacture of an aphrodisiac. Present laws prohibit indiscriminate killing of sea lions, but fishermen may destroy the animals when they interfere with fishing activities. The amount of harm done to the fish population by the sea lions is a moot question. People who are interested in these animals from an esthetic point of view claim that they eat almost no fish, and are harmless. Fishermen, on the other hand, claim that the sea lions eat enough fish to endanger the supply. The truth probably lies at some midpoint between these two extremes. Certainly sea lions eat some fish, but not enough to menace the marine fish off the California coast. They do, however, seriously interfere with fishing activities. Purse seine fishermen find at times that the sea lions will frighten a school of fish before it can be surrounded by the net, or the sea lion will be caught in the circle with the fish, resulting in net damage. Set line and gill net fishermen find that a sea lion may take one bite out of each fish caught in the gear, thus damaging many fish, although the amount eaten by the sea lion is small. Mackerel scoop fishermen frequently get a school of fish chummed up ready for dipping when a sea lion comes along and frightens the fish away. Because of these depredations on fishing activities, the

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FIGURE 3. Sea lions on Ano Nuevo Island, June 14, 1946. Photograph by U. S. Navy Blimp Squadron 31, Detachment 1, Moffet Field, California.

killing of such sea lions when actually interfering with fishing has been legalized. In spite of this, complaints against the sea lions persist; and the California Division of Fish and Game is repeatedly asked to take steps to reduce the size of the herds.

To check upon these claims of increased numbers, seven counts of the sea lion population have been made in the following years: 1927, 1928, 1930, 1936, 1938, 1939, and 1946. The 1939 census was made in the winter, and did not cover the entire coast. It is, therefore, not directly comparable, and has been omitted from this report. The results of the

other counts are summarized in Table 1. Prior to 1946 each census was made by surveying the rookeries and hauling grounds from a boat. These counts were carried on during June when the animals were hauled out on the rocks for whelping. In 1946 an airplane and Navy blimps were used, as well as boats. Aerial photographs were taken and used to supplement the visual counts.

For the 1946 census the Bureau of Marine Fisheries was aided by the Bureau of Patrol through the use of the Division of Fish and Game airplane, patrol boats, and patrol staff. In addition, U. S. Navy Blimp Squadrons from Moffett Field and Santa Ana took staff members on three flights, made aerial photographs, and furnished prints. The help of these agencies is gratefully acknowledged.

When the census was made by visiting a rookery with a boat, two or more people made independent counts or estimates, and the results were averaged. Under such methods experienced observers can be fairly accurate, and it is possible to distinguish between Steller and California sea lions. From an airplane or blimp, counts and estimates can be made but the two species cannot be distinguished. Aerial photographs have proved very useful as a check on such counts or estimates, but these also do not permit a distinction between species. Flights by air have the great advantage of permitting coverage of all state waters in two or three days, thus completing the counts before the sea lions have had time to move from rookery to rookery. Similar coverage by a boat requires two or more weeks.

Because species were not distinguished in the 1946 census, counts of both Steller and California sea lions are combined in Table 1. Although there is an overlap of the two species in Central California, a rough comparison of numbers can be made by considering all animals north of Point Conception as Steller, and all south as California. Such sub-totals for Northern and Southern California are included in the table. The localities along the mainland are listed from the north to the south. The northermost is from St. George Reef south to and including Cape Mendocino. The next locality listed "To Pt. Arena" includes the mainland just south of Cape Mendocino to and including Pt. Arena. The remaining localities are similarly designated along the coast. The off-shore islands are listed separately.

From Table 1 it is evident that the sea lion population of Northern California has not materially changed in the 20-year interval over which counts have been made. The 5,168 animals counted in 1946 fall within the range of three to six thousand counted in former years. Fluctuations have occurred on different rookeries and hauling grounds, but these show no definite trends. We may thus conclude that the Steller sea lion population is comparatively stable. In Southern California the situation differs. Here there has been an increase in numbers from about 1,500 to 4,000 in the succession of years, and by 1946 the count of 7,338 was well above that of any previous year. In contrast to the Steller sea lions, the California sea lions give evidence of a continued numerical increase. The winter counts of 1939, which were fairly complete for Southern California, gave 5,275 sea lions south of Point Conception. This further suggests that the increase in numbers of California sea lions has been gradual over a period of 10 or more years.

TABLE I

Number of Seal Lions Counted on Rookeries and Hauling Grounds in Various Years

Locality	1927	1928	1930	1936	1938	1946
St. George Reef to Cape Mendocino	2,400	1,511	1,600	1,452	918	902
To Pt. Arena	300	206	300	142		148
To Pt. Reyes				54	6	111
To Pigeon Point	150	42		4	2	59
Farallon Islands	706	540	928	525	447	950
Pt. Ano Nuevo	1,500	1,500	2,500	1,200	2,000	1,900
To Pt. Lobos		270	209	338	191	402
To Pt. Conception	557	337	357	509	415	696
Northern California	5,613	4,406	5,894	4,224	3,979	5,168
To Pt. Loma (Mainland)						36
San Miguel Island	744	1,021	825	1,879	2,706	2,819
Santa Rosa Island	49	38	12	52	20	
Santa Cruz Island	233	203	208	200	141	1,075
Anacapa Island	34	27	11	11	10	81
Santa Barbara Island	125	327	8	600	500	2,056
San Clemente Island	265	251	347	435	490	883
Santa Catalina Island					15	104
San Nicolas Island	Not visited	Not visited	Not visited	Not visited	Not visited	284
Southern California	1,450	1,867	1,411	3,177	3,882	7,338
All California	7,063	6,273	7,305	7,401	7,861	12,506

Present laws empower the California Division of Fish and Game to reduce the herd, if such reduction appears advisable, and practical means for reduction are now being worked out. It is hoped that a system of permits will prove satisfactory. Under such permits, private individuals will be allowed to take a certain number of animals for commercial use, chiefly reduction into meal and oil. Two such permits have been issued and to date one hundred sea lions have been taken north of Point Conception and one hundred ten south. Permits are also issued for the taking of California sea lions for zoos and for trained animal acts. Such permits average about one hundred animals each year.

In the course of the 1946 survey, in addition to the 12,506 sea lions, 550 harbor seals and 21 elephant seals were counted. The counts of harbor seals are incomplete but it seems probable that the total population does not exceed one thousand animals. Presumably most of the elephant seals in our waters were observed.

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THE EFFECT OF EXPLOSIVES ON MARINE LIFE

By J. A. Aplin
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This series of observations and experiments was undertaken to determine the damage to fish and other marine life from the use of explosives in geophysical survey work to locate oil deposits along the California coast. Such work is carried on under special permit issued by the California Division of Fish and Game.

The weight of explosive used for any section of coast surveyed for oil is fairly constant. If the observations on fish killed showed consistent results then an estimate of the number of fish which might be killed by further survey work could be made. The explosive used was 60 percent petrogel in 10 pound sticks.

Observations intended as a random sample of the survey work done over a period of several months were made off the Southern California coast from Santa Barbara to Huntington Beach.

When the sea was choppy, less accurate estimates of dead fish could be made than when the weather was calm but there was some indication that few fish were killed during rough weather. As it was possible to get more accurate estimates on calm days these were selected for the observations and may tend to overweight the results. Table 1 shows the estimated weights of fish that were observed killed. Averages calculated from the tables indicate that about five pounds of fish of all kinds were killed per pound of powder expended and approximately one hundred pounds per shot. The weights of the charges tabulated were 10 shots of 10 pounds each, 18 charges of 20 pounds, and 18 charges of 40 pounds. The average charge weight was 25.6 pounds. For shots within this range, 10 to 40 pounds, there is no noticeable difference in weight of fish killed. Successive shots in the same area continue to kill fish so the greater the number of shots the greater the number of fish that will be killed.

Of the fish killed, anchovies, kingfish, sardines, queenfish, and smelt made up more than 90 percent of the total weight, due presumably to the fact that these species were present in greatest numbers in the areas where the operations were carried out. Where available 10 fish of each species were examined to determine the kind of damage which had caused death. In all cases the air bladder had burst. This was apparently enough to cause death. However, most individuals also showed ruptured blood vessels. In some cases all of the contents of the body cavity had been crushed and the ribs broken. Some fish are apparently stunned by the explosion but later recover sufficiently to swim away. As no fish were picked up that were not badly damaged internally it is probable that any fish hurt enough to once come to the surface will eventually die. The ability to recover after being stunned is particularly characteristic of barracuda. The greatest damage to fish was observed on two occasions when shots

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were fired close inshore off Huntington Beach. On April 3, 1946, about two hundred pounds of spot-fin croakers of about two pounds each were washed up on the beach after several shots had been fired. This was a rather unusual condition as only a small proportion of the total shots are fired that close to a shore where fish are plentiful. On April 18th an area 1½ miles off Huntington Beach was examined after approximately five hundred pounds of explosive had been fired in about 10 shots. Three hundred pounds of kingfish, two hundred pounds of queenfish, twenty pounds of perch, and forty pounds of barracuda had been killed. One hour later a location one-half mile farther off shore showed no fish of any kind killed by two shots of 20 pounds and one of 40 pounds. In general the greatest number of fish were killed by the shots closest to shore. This presumably resulted because there is a greater abundance of fish in the inshore area.

Experiments on Fish

As a further test of the effect of explosives the following experiments were carried out. Several holding compartments were made of welded iron frames covered with ½-inch-mesh galvanized wire hardware cloth. They were three feet square and 18 inches deep. Floats were attached to the top so the cages would float with their tops just at the surface of the water. During similar experiments made in Louisiana it was found wooden cages would be broken up by the explosions unless so heavily built as to give the impounded fish definite protection from the shock. The fish for the experiments were caught in a lampara net or by hook and line. They were transported to the blasting area in a tank supplied with circulating sea water. After being exposed to the blast they were kept in the compartment suspended from a dock or placed in an aquarium tank at the Kerckhoff Laboratory of the California Institute of Technology. The courtesy of this institute in providing these facilities is gratefully acknowledged.

The following fish were put into the compartment and were moved progressively closer to the shots. One ¾-pound spotfin croaker (*Roncador stearnsi*), two ½-pound kingfish (*Genyonemus lineatus*), and one ½-pound smelt (*Atherinopsis californiensis*), were killed 250 feet away by a 40-pound charge exploded at a depth of four feet. (This is the depth usually used in geophysical survey work in Southern California). Two 1½-pound white sea-bass (*Cynoscion nobilis*), and two 2-pound spotfin croakers were killed by an equal charge 75 feet away. This blast did not kill two rays (*Urolophus halleri*), weighing about a pound each or a guitar fish (*Rhinobatus productus*), weighing about four pounds.A 20-pound charge at four feet depth and 50 feet away horizontally killed two opal-eye perch (*Girella nigricans*), and reduced their viscera to a pulp. However, four sculpin (*Scorpaena guttata*) and a cabezone (*Scorpoenicthys marmoratus*), of about a pound each which were in the cage at the same time were not hurt. Six days later they were killed and their viscera examined and no damage of any sort was found. These fish have no air bladders and are definitely bottom fish.

Three California halibut (*Paralicthys californicus*), weighing about two pounds each were exposed to a 20-pound charge fired four feet below the surface. They were 55-feet from the charge and on the bottom directly

below it. Three hours later they were all alive and when killed their viscera showed no evidence of damage. In a following experiment four halibut of about the same size were exposed to a shot of the same weight and at the same distance. One additional fish was kept as a control. After the experiment one of the fish died in about 12 hours. However this was apparently from injuries received when hooked. The other three and the control were alive and active at the end of three weeks. Soon after the blast the experimental fish all developed red areas along the dorsal and ventral edges of their caudal fins. By the end of the three weeks this color had almost entirely faded out. The fish were killed and an examination of their viscera showed no signs of damage.

FIGURE 4. Explosion of twenty pounds of dynamite fired four feet below the surface. Dark object above column of water is the float used to buoy the charge.

It appears that fish with air bladders are much more susceptible to concussion than those without. As those with air bladders are the ones that will float (unless completely crushed), observations on floating dead fish after explosions should include almost all fish killed.

Experiments on Abalones

Four rough abalones (*Haliotis corrugata*) and four green abalones (*Haliotis fulgens*) ranging from 100 mm. to 175 mm. in greatest diameter were exposed to a 20-pound blast fired four feet below the surface. They were on the bottom and 55 feet from the explosion. The shell of one abalone was broken but as this was an aberrant individual with an unusually thin shell it can perhaps be overlooked. An hour after the experiment all the other abalones were able to move slightly when given tactile stimulation. However none of them extended their mantles when put into the aquarium and all were dead within a few hours. Though

this may indicate abalones are more susceptible to concussion than some kinds of fish further experiments will have to be made as they may have been killed by handling and transportation.

Experiments on Lobsters

Eight lobsters (*Panulirus interruptus*) 27 to 30 cm. long were exposed to a 20-pound charge fired four feet below the surface. They were on the bottom 55 feet from the shot and almost directly below it. The lobsters were all alive and active five hours later and when killed their viscera showed no signs of damage. In another experiment 13 lobsters ranging from 17 to 23 cm. in length were exposed to a 20-pound

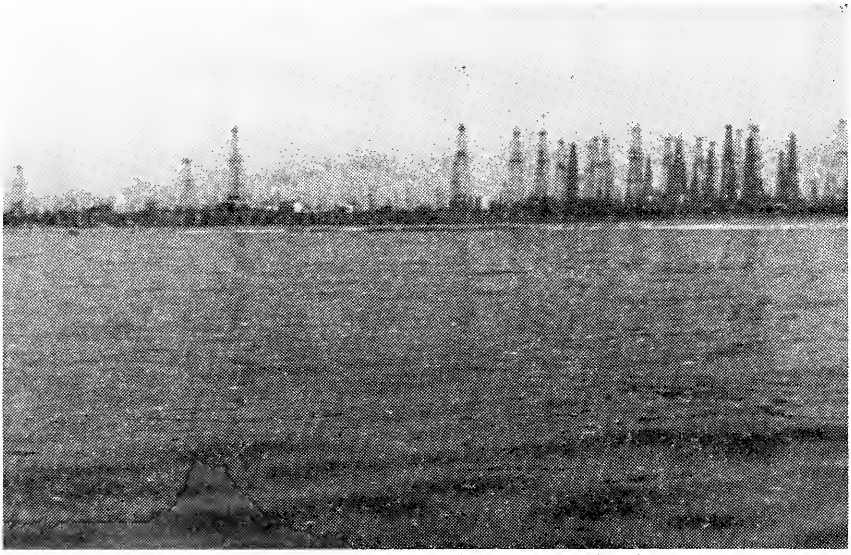

FIGURE 5. Floating fish killed by blast shown in Figure 4.

shot fired four feet below the surface. In this test the lobsters were four feet below the surface and 50 feet away from the shot. Three hours later they were all alive and when killed their viscera showed no signs of damage. Apparently lobsters are very resistant to concussion and it is doubtful if any are hurt by seismic survey work.

Effects of Concussion on Schools of Fish

It has often been stated that concussions will drive fish out of an area. However a school of anchovies that were circling the survey ship at the time the blasts were being fired did not leave the area even after several charges had been fired about 20 minutes apart. The sound of these explosions inside the ship's hull was about equal to that of firing a medium calibre pistol in a closed room.

The author also had an opportunity to observe the effect of concussions on fish off the coast of Leyte in the Philippine Islands. Charges of three hundred pounds of explosive were being used to clear reefs from the dock area and none of the personnel of ships anchored within a

mile were allowed to go into the water because of the danger from concussion. At the same time there were three schools of tuna breaking the surface within sight of the anchored ships. They were feeding upon small fish about two inches long that were very plentiful in the area. The estimated weight of the tunas was 20 pounds. They did not leave the region and were not easily frightened. They would frequently jump out of the water within 30 feet of small boats which would run through their schools almost unnoticed.

Conclusions

There is no apparent relation between depth of water or size of explosive charge and the weight of fish killed. The more shots fired the greater the kill because of the greater chance that fish will be in the area. Shots closest to shore produce most dead fish as fish are more abundant just outside the surf.

In the Santa Barbara-Ventura area the average weight of fish killed was one hundred to two hundred pounds per shot.

Fish with air bladders are much more likely to be killed than those without. Explosions do not appear to harm lobsters but abalones may be damaged.

Seismic survey work in any given area should be scheduled when the fish population is at a minimum if such times can be determined.

TABLE 1

Pounds of Fish Observed Killed by Seismic Shots of Various Weights Fired at Different Depths

Locality and date	Depth of water, fathoms	Weight of explosive, lbs.	Depth of explosive, ft.	Pounds of fish killed										Total
				Anchovie	Sardine	Kingfish	Queenfish	Perch	Barracuda	Croaker	Shad	White Sea-bass	Smelt	
1½ mi. off Rincon Pt.	15	10	4	10				1						11
	15	20	4	10										10
	15	40	4	25	50									75
November 14, 1945	15	40	20	15					125					140
Total		110		60	50			1	125					236
1¼ mi. off Pt. Gorda	14	10	4	20				2						22
November 15, 1945	14	20	4	10										10
	14	40	4	20	20					3	6			49
	14	40	4		1,000									1,000
	14	20	20			10	3							13
	14	10	4			2								2
	14	20	20			20	5	1			3			29
	14	40	4			5								5
Total		200		50	1,020	37	8	3		3	9			1,130
½ mi. west of Pt. Gorda	6	10	4		1,000									1,000
November 16, 1945	6	20	4		500	10	5							515
	6	40	4		100	5	2	2						109
	6	40	4		10									10
	6	10	3			5	2	1						8
	6	20	4			1								1
	6	40	4		500			1						501
	6	40	4			1						10		11
Total		220			2,110	22	9	4				10		2,155
1¾ mi. off Pt. Las Pitas	14	10	4			5	2						1	8
November 19, 1945	14	20	4			2	2							4
	14	40	4	100	500	5	2							607
	14	40	4			1								1
Total		110		100	500	13	6						1	620

1¼ mi. off Pt. Las Pitas	10	10	4	50		15	10							75
November 20, 1945	10	20	4	10				5	30					45
	10	20	20	500	500	15	5							1,020
	10	40	4			10	5			8				23
	10	20	4			50	10	1			3			64
	10	20	4			10	5						2	17
	10	40	4										200	200
Total		170		560	500	100	35	6	30	8	3		202	1,444
1¼ mi. off Pt. Las Pitas	10	20	4	20		20	10							50
November 21, 1945	10	20	4	10		10	5							25
	10	40	4	50		10	5							65
	10	40	4	2		1	1			6		4		14
Total		120		82		41	21			6		4		154
3 mi. off Ventura	11	10	4	25		10		1						36
January 23, 1946	11	20	4		20	5							20	45
	11	40	4	10		10							10	30
Total		70		35	20	25		1					30	111
3 mi. off Ventura	11	10	4	5		10					3			18
January 24, 1946	11	20	4	20		5								25
	11	20	4	20		10				3				33
	11	20	8	40		10					3			53
	11	40	4	50		10				5			1	66
Total		110		135		45				8	6		1	195
1 mi. off Ventura	10	10	4			10		2					10	22
January 25, 1946	10	20	4	10		5							5	20
	10	40	4	5		10							5	20
Total		70		15		25		2					20	62
Grand total		1,180		1,037	4,200	308	79	17	155	25	18	14	254	6,107

TABLE 2

Scientific Names of Fish Listed in Table 1

Anchovy	*Engraulis mordax*
Barracuda	*Sphyraena argentea*
Croaker	*Roncador stearnsi; Umbrina roneador*
Kingfish	*Genyonemus lineatus*
Perch	*Rhacochilus toxotes; Phanerodon furcatus; Amphystichus argenteus*
Queenfish	*Seriphus politus*
Sardine	*Sardinops caerulea*
Shad	*Alosa sapidissima*
Smelt	*Atherinopsis californiensis; Leuresthes tenuis*
White sea-bass	*Cynoscion nobilis*

PISMO CLAMS OF SAN QUINTIN, LOWER CALIFORNIA[1]

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In the latter half of 1941 experiments were made on the importation of Pismo Clams *(Tivela stultorum)* from Mexico. The clams were dug and shucked on the beaches of the Lower California peninsula and the meats shipped under refrigeration to the Long Beach-Los Angeles Harbor

FIGURE 6. Opening Pismo clams on beach at San Quintin, Lower California. Note five gallon container in background.—*Photograph by J. A. Aplin.*

by boat. Here they were canned by a modification of the method used for tuna. The initial experiments proving successful, more plants undertook clam canning, and the amounts imported increased rapidly. In 1945, 6,677,000 pounds of clam meats with a value of $1,430,000 were imported from Lower California. Although most of this quantity is still being transported by boat some refrigerated trucks are now used for the shorter hauls. Both methods of transportation have their drawbacks. Carrying the cans of clam meats out through the surf to a vessel anchored off shore is difficult and dangerous and the places where there are dock facilities are quite limited. On the other hand, clams can only be trucked from the nearer sources as the roads are too rough to justify long hauls and are entirely impassable in wet weather.

[1] Submitted for publication October, 1946.

The following observations on clam digging were made at San Quintin which is 220 miles by road south of the border town of Tijuana. Although this is not one of the major sources of clams from Mexico there are five miles of productive beach and its available supply has scarcely been touched. Less than a hundred tons of clam meats have been taken during the past year. The methods used at San Quintin are the same as those on other clam beaches.

The diggers can work in a tide as unfavorable as plus two feet although this reduces their efficiency and they cannot work as long because of the cold water. If the diggers were supplied with boots their time spent digging could be considerably increased. The earlier method was to locate the clams by touch, the men using their feet to find them. As the clams are just at the surface of the sand when covered with water

FIGURE 7. Shucking Pismo clams on the beach at San Quintin, Lower California. —*Photograph by J. A. Aplin.*

this procedure is not too difficult though rather slow. Now that forks are available the clams are located by prodding. As the clams are dug they are dropped into a burlap bag with a grommet in the top to hold it open. The bag is dragged along behind the digger until about a hundred and fifty pounds of clams have been gathered.

In the shallow water they are loaded on a wheelbarrow and moved back above the high tide line to the place where they will be shucked. The wheelbarrows used have especially broad rims on their wheels to prevent them from sinking into the wet sand. The clams are opened on the beach by a man using a hinged knife much like a photograph trimmer. The diggers work in groups and one man operating the opening knife can keep two men busy shucking. The meat is removed from the shell with a short bladed knife and is dropped into a tub where it is washed in sea water to remove any sand which might have been inside the shell. The loss of the natural juices of the clam is to be regretted as it would

add materially to the flavor of the finished product. The meats are then put into friction-lidded cans of five gallons capacity, each holding 40 pounds of clam meats. The ratio is eight pounds of live clams to one pound of cleaned meats. At this location the price was two dollars per can of 40 pounds. Depending on the individual, each member of the group can dig and clean from two to seven cans of meats on every tide lower than the zero reference line.

The truck which is to take the clams to the cannery brings a partial load of ice to the beach. When the truck arrives digging begins and as there are only eight diggers at this location about three days work is required to gather a truckload. The cans are packed in ice immediately after filling and just as soon as the load is completed the truck starts for the cannery, a haul of about three hundred and fifty miles. At the cannery the meats are minced and packed in the same sized cans ($7\frac{1}{2}$-oz.) as are commonly used for tuna.

PUBLICATIONS OF THE CALIFORNIA FISH AND GAME COMMISSION[1]

INTRODUCTION

There has been no formal listing of the publications of the California Fish and Game Commission since the compilation by Bryant[*] for the period 1870-1920. Although, from time to time, mimeographed lists of available publications have been prepared, these lists are now all out of date.

The important publications of the commission have included: (1) biennial reports (a report to the Governor required by law); (2) California fish and game laws (a compilation of the laws relating to fish and game, primarily for the use of law enforcement agencies); (3) fish bulletins and game bulletins (publications giving the results of scientific investigations); (4) circulars (statistical reports of fishery products); (5) teacher's bulletins (a series designed for the use of teachers in the public schools); and (6) a magazine, California Fish and Game, published quarterly since October, 1914. Frequently special bulletins and leaflets have been printed for distribution to serve some immediate purpose and the various bureaus of the California Division of Fish and Game have stocked reprints from California Fish and Game and from other publications for added distribution.

Files of the above publications are maintained in libraries throughout the world for the use of investigators and students of wildlife research and management. This field of research has seen a tremendous growth in recent years and many new organizations are anxious to obtain complete sets of our publications for their libraries. Unfortunately many of our stocks have been exhausted and we are unable to fill all of these requests. Added to this, many foreign organizations did not receive these publications during the war period and are now desirous of completing their series. In the following compilation it is indicated which publications are out of print. It would be greatly appreciated if our readers would check over these lists with their own files and send the editor any spare copies that are out of print so that we can better complete the files of libraries requesting such material.

All of the publications listed with but a few exceptions have been published by the State Department of Printing at Sacramento.

BIENNIAL REPORTS

The first biennial report appeared in 1872, for the period 1870-1871, with the title "Report of the Commissioners of Fisheries of the State of California." The report published in 1880 was the only report which covered but a single year. All subsequent reports, from that covering

[1] Submitted for publication December, 1946.

[*] Bryant, H. C., Publications of the California Fish and Game Commission, 1870-1920. California Fish and Game, Vol. 7, No. 2, pp. 87-98.

the years 1881-1882, to date have covered a biennial period. With the report for 1881-1882 the title was changed "Biennial Report of the Commissioners of Fisheries of the State of California." The report for the years 1887-1888, and the two subsequent reports bore the title "Biennial Report of the State Board of Fish Commissioners of the State of California." The report for the period 1893-1894 was titled "Thirteenth Biennial Report of the State Board of Fish Commissioners of the State of California" and all subsequent reports were numbered serially, that for the period 1942-1944 being the thirty-eighth. The twentieth report, under the title "Twentieth Biennial Report and Financial Statement of the State Board of Fish Commissioners," was not printed for distribution but appeared as an appendix of the twenty-first biennial report. With changes in the name of the commission the next report was titled "Twenty-second Biennial Report of the Fish and Game Commission of the State of California" and all subsequent reports have carried the same title with the correct serial number.

Frequently the earlier reports were used as a medium for publication of original research papers but beginning with the twenty-fourth, the Biennial Reports consisted of the report only, such papers as had been included heretofore being henceforth published as bulletins or in the quarterly California Fish and Game. A list of these early papers which appeared in the Biennial Reports appeared in the compilation by Bryant referred to in the introduction.

CALIFORNIA FISH AND GAME LAWS

The first edition of the fish and game laws of the State of California appeared in 1885. There is no record available of the second edition, but that published in 1887 was titled third edition. The laws were then published in odd years through 1909. The 15th edition covered the period 1911-12; the 16th, 1913-14; the 17th, 1914-15; the 18th, 1915-17; and from then on the laws have been published every two years, the last edition being the 34th, for the period 1945-47.

The first 14 editions were entitled "The Fish and Game Laws of the State of California." The 15th through the 19th editions were entitled "State of California Fish and Game Laws." The 20th through the 27th editions were entitled "State of California Laws Relating to Fish and Game." The 28th edition, through to the present time, was entitled "State of California Fish and Game Code." All editions since the 20th (1917-1919) were compiled by J. S. Hunter, currently Chief, Bureau of Game Conservation. For the names of earlier compilers see Bryant's lists referred to in the introduction.

These laws have usually been published in a small pocket-sized edition, although a limited number of copies were also published in a larger format. Since about 1903 the commission has also published for distribution abstracts of these laws, usually in two sizes, one for mailing and the other as a poster. Since 1915-17, a similar issue has been made of the Abstract of Laws pertaining to Commercial Fisheries. Only recent issues are still available for distribution.

FISH BULLETINS

* No. 1. Report on Fish Conditions. 1913; 48 pp., 3 figs.

* No. 2. The Scientific Investigation of Marine Fisheries, as Related to the Work of the Fish and Game Commission in Southern California. By Will F. Thompson. 1919; 27 pp., 4 figs.

* No. 3. The Spawning of the Grunion (*Leuresthes tenuis*). By Will F. Thompson, assisted by Julia Bell Thompson. 1919; 29 pp., 9 figs.

* No. 4. The Edible Clams, Mussels and Scallops of California. By Frank W. Weymouth. 1920; 74 pp., 19 pls., 26 figs.

* No. 5. A Key to the Families of Marine Fishes of the West Coast. By Edwin C. Starks. 1921; 16 pp., 4 figs.

* No. 6. A History of California Shore Whaling. By Edwin C. Starks. 1923; 38 pp., 22 figs.

* No. 7. The Life History and Growth of the Pismo Clam. By Frank W. Weymouth. 1923; 120 pp., 15 figs., 18 graphs.

* No. 8. Racial and Seasonal Variation in the Pacific Herring, California Sardine and California Anchovy. By Carl L. Hubbs. 1925; 23 pp., 4 pls.

* No. 9. Preliminary Investigation of the Purse Seine Industry of Southern California. By Tage Skogsberg. 1925; 95 pp., 23 figs.

* No. 10. The Life History of *Leuresthes tenuis*, an Atherine Fish with Tide Controlled Spawning Habits. By Frances N. Clark. 1925; 51 pp., 6 graphs, 7 pls.

* No. 11. The California Sardine. By the Staff of the California State Fisheries Laboratory. 1926; 221 pp., 74 figs.

* No. 12. The Weight-Length Relationship of the California Sardine (*Sardina caerulea*) at San Pedro. By Frances N. Clark. 1928; 58 pp., 11 figs.

* No. 13. The Seasonal Average Length Trends at Monterey of the California Sardine (*Sardina caerulea*). By Carroll B. Andrews. 1928; 12 pp., 6 figs.

* No. 14. Report on the Seals and Sea Lions of California. By Paul Bonnot. 1928; 61 pp., 38 figs.

* No. 15. The Commercial Fish Catch of California for the years 1926 and 1927. By the Bureau of Commercial Fisheries. 1929; 93 pp., 52 figs.

No. 16. The Life History of the California Jack Smelt (*Atherinopsis californiensis*). By Frances N. Clark. 1929; 22 pp., 12 figs.

* No. 17. Sacramento-San Joaquin Salmon (*Oncorhynchus tschawytscha*) Fishery of California. By G. H. Clark. 1929; 73 pp., 32 figs.

* No. 18. The Pismo Clam: Further Studies of Its Life History and Depletion. By William C. Herrington. 1930; 67 pp., 16 figs.

* No. 19. Sardine Fishing Methods at Monterey, California. By W. L. Scofield. 1929; 61 pp., 27 figs.

* No. 20. The Commercial Fish Catch of California for the Year 1928. By the Staff of the Bureau of Commercial Fisheries. 1930; 109 pp., 62 figs.

* Out of print.

* No. 21. Analysis of Boat Catches of White Sea Bass (*Cynoscion nobilis*) at San Pedro, California. By S. S. Whitehead. 1930; 26 pp., 20 figs.

* No. 22. A Bibliography of the Tunas. By Genevive Corwin. 1930; 103 pp.

* No. 23. Success of the Purse Seine Boat in the Sardine Fishery at Monterey, California (1929-1930 Fishing Season). By J. B. Phillips. 1930: 28 pp., 19 figs.

* No. 24. An Analysis of the Catch Statistics of the Striped Bass (*Roccus lineatus*) Fishery of California. By J. A. Craig. 1930; 41 pp., 22 figs.

* No. 25. Fishing Areas Along the California Coast for the Sardine (*Sardina caerulea*). By the California State Fisheries Laboratory. 1930; 44 pp., 25 figs.

No. 26. Seasonal Changes in the Daily Average Length of the California Sardine (*Sardina caerulea*). By Frances N. Clark. 1930; 20 pp., 11 figs.

* No. 27. The Ring Net, Half Ring Net, or Purse Lampara in the Fisheries of California. By Donald H. Fry, Jr. 1931; 65 pp., 28 figs.

* No. 28. Handbook of Common Commercial and Game Fishes of California. By Lionel A. Walford. 1931; 181 pp., 137 figs.

* No. 29. The Striped Bass of California. By Eugene C. Scofield. 1931; 82 pp., 47 figs.

* No. 30. The Commercial Fish Catch of California for the Year 1929. By the Staff of the Bureau of Commercial Fisheries. 1931; 133 pp., 75 figs.

No. 31. Studies of the Length Frequencies of the California Sardine (*Sardina caerulea*). By the California State Fisheries Laboratory. 1931; 53 pp., 24 figs.

* No. 32. The California Halibut (*Paralichthys californicus*) and an Analysis of the Boat Catches. By G. H. Clark. 1931; 52 pp., 25 figs.

No. 33. Fishing Methods for the Bluefin Tuna (*Thunnus thynnus*) and an Analysis of the Catches. By S. S. Whitehead. 1931; 32 pp., 22 figs.

No. 34. Salmon of the Klamath River, California. By John O. Snyder. 1931; 130 pp., 44 figs.

* No. 35. A Distributional List of the Species of Freshwater Fishes Known to Occur in California. By Barton W. Evermann and Howard Walton Clark. 1931; 67 pp.

No. 36. A Bibliography of the Sardines. By Genevieve C. Wheeler. 1931; 133 pp.

No. 37. The California Barracuda (*Sphyraena argentea*). By Lionel A. Walford. 1932; 120 pp., 32 figs., 6 pls.

No. 38. The California Shrimp Industry. By Paul Bonnot. 1932; 20 pp., 11 figs.

No. 39. Fluctuations in the Abundance of Striped Bass (*Roccus lineatus*) in California. By G. H. Clark. 1933; 18 pp., 7 figs.

No. 40. The California Mackerel Fishery. By Richard S. Croker. 1933; 149 pp., 73 figs.

No. 41. Early Life History of the California Sardine (*Sardina caerulea*), with Special Reference to Distribution of Eggs and Larvae. By Eugene C. Scofield. 1934; 48 pp., 24 figs.

No. 42. Maturity of the California Sardine (*Sardina caerulea*), Determined by Ova Diameter Measurements. By Frances N. Clark. 1934; 49 pp., 19 figs.

* Out of print.

No. 43. The Sizes of California Sardines Caught by the Different Fishing Gear and in the Different Localities of the Monterey and San Pedro Regions. By the California State Fisheries Laboratory. 1935; 59 pp., 27 figs.

No. 44. The Commercial Fish Catch of California for the Years 1930-1934, inclusive. By the Staff of the Bureau of Commercial Fisheries. 1935; 124 pp., 19 figs.

No. 45. The Sharks and Rays of California. By Lionel A. Walford. 1935; 66 pp., 58 figs.

No. 46. A Contribution toward the Life Histories of Two California Shrimps, *Crago franciscorum* (Stimpson) and *Crago nigricauda* (Stimpson). By Hugh R. Israel. 1936; 28 pp., 9 figs.

No. 47. Interseasonal and Intraseasonal Changes in Size of the California Sardine (*Sardinops caerulea*). By Frances N. Clark. 1936; 28 pp., 11 figs.

No. 48. Fishing Localities for the California Sardine, *Sardinops caerulea*, 1928-1936. By Frances N. Clark. 1937; 11 pp., 5 figs.

No. 49. The Commercial Fish Catch of California for the Year 1935. By the Bureau of Commercial Fisheries. 1937; 170 pp., 114 figs.

No. 50. Sizes of California Sardines Caught in the Different Areas of the Monterey and San Pedro Regions. By J. B. Phillips. 1937; 31 pp., 12 figs.

No. 51. The High Seas Tuna Fishery of California. By H. C. Godsil. 1938; 41 pp., 20 figs.

No. 52. Historical Account of the Los Angeles Mackerel Fishery. By Richard S. Croker. 1938; 62 pp., 37 figs.

No. 53. Measures of Abundance of the Sardine, *Sardinops caerulea*, in California Waters. By Frances N. Clark. 1939; 45 pp., 19 figs.

No. 54. The Fishes of the Family Sciaenidae (Croakers) of California. By Tage Skogsberg. 1939; 62 pp., 16 figs.

No. 55. Report on Returns of Drift Bottles Released Off Southern California, 1937. By Richard B. Tibby. 1939; 36 pp., 22 figs.

No. 56. Development of the Eggs and Early Larvae of Six California Fishes. By Paul L. Budd. 1940; 50 pp., 12 pls.

No. 57. The Commercial Fish Catch of California for the Years 1936-1939, Inclusive. By the Staff of the Bureau of Marine Fisheries. 1940; 100 pp., 9 figs.

No. 58. The Commercial Fish Catch of California for the Year 1940. By the Staff of the Bureau of Marine Fisheries. 1941; 47 pp., 7 figs.

No. 59. The Commercial Fish Catch of California for the Years 1941 and 1942. By the Staff of the Bureau of Marine Fisheries. 1944; 68 pp., 8 figs.

No. 60. A Systematic Study of the Pacific Tunas. By H. C. Godsil and Robert D. Byers. 1944; 131 pp., 76 figs.

No. 61. Results of Tagging Experiments in California Waters on the Sardine, *Sardinops caerulea*. 1945; 90 pp., 15 figs.

No. 62. Catch per Unit of Effort in California Waters of the Sardine, *Sardinops caerulea*, 1932-42. By Ralph P. Silliman and Frances N. Clark. 1945; 76 pp., 22 figs.

No. 63. The Commercial Fish Catch of California for the Years 1943 and 1944. By the Staff of the Bureau of Marine Fisheries. 1946; 81 pp., 6 figs.

No. 64. The Biology of the Soupfin, *Galeorhinus zyopterus*, and Biochemical Studies of the Liver. 1946; 96 pp., 41 figs.

No. 65. Analysis of Populations of the Pacific Sardine on the Basis of Vertebral Counts. By Frances N. Clark. 1947; 26 pp., 3 figs.

GAME BULLETINS

* No. 1. Report on Game Conditions; 1913; 67 pp., 8 figs. Contains:

a. Investigation of the Large Game Situation in California With Special Reference to deer. By Frank C. Clarke.

b. Present and Future Status of the California Valley Quail. By Harold C. Bryant.

c. Introduction of Foreign Game Birds Into the Southern San Joaquin and Tributary Sections. By A. D. Ferguson.

d. Educating the Young People as to the Need and Value of Wild Life Conservation. By Gretchen L. Libby.

e. Investigation of the Economic Status of Nongame Birds. By H. C. Bryant.

No. 2. The Quail of California. By Donald D. McLean. 1930; 47 pp., 15 figs.

No. 3. The Status of Beavers in California. By Donald T. Tappe. 1942; 59 pp., 26 figs.

CIRCULARS

Statistical Report on Fresh and Canned Fishery Products, 1926. Circular No. 1, May, 1927.

Statistical Report on Fresh and Canned Fishery Products, 1927. Circular No. 2, August, 1928.

Statistical Report on Fresh and Canned Fishery Products, 1928. Circular No. 3, June, 1929.

Statistical Report on Fresh and Canned Fishery Products, 1929. Sardine cannery report season 1929-1930. By S. H. Dado. Circular No. 4, April, 1930.

Statistical Report on Fresh and Canned Fishery Products, 1930. Sardine cannery report season 1930-1931. By S. H. Dado. Circular No. 5, April, 1931.

Statistical Report on Fresh and Canned Fishery Products, 1931. Sardine cannery report season 1931-1932. By S. H. Dado. Circular No. 6, April, 1932.

Statistical Report on Fresh and Canned Fishery Products, 1932. Sardine plant report season 1932-1933. By S. H. Dado. Circular No. 7, April, 1933.

Statistical Report on Fresh and Canned Fishery Products, 1935. Sardine plants report season 1935-1936. By S. H. Dado. Circular No. 10, May, 1936.

Statistical Report on Fresh and Canned Fishery Products, 1936. Sardine plants report season 1936-1937. By S. H. Dado. Circular No. 11, May, 1937.

Statistical Report on Fresh and Canned Fishery Products, 1938. Sardine canning and reduction plants report season 1938-1939. By S. H. Dado. Circular No. 13, 1939.

Statistical Report on Fresh and Canned Fishery Products, 1939. Sardine canning and reduction plants report season 1939-1940. By S. H. Dado. Circular No. 14, 1940.

Statistical Report on Fresh and Canned Fishery Products, 1940. Sardine canning and reduction plants report season 1940-1941. By S. H. Dado. Circular No. 15, 1941.

Statistical Report on Fresh and Canned Fishery Products, 1941. Sardine canning and reduction plants report season 1941-1942. Circular No. 16, 1942.

Statistical Report on Fresh and Canned Fishery Products, 1942. Sardine canning and reduction plants report season 1942-1943. Circular No. 17, 1943.

* Out of print.

Statistical Report on Fresh and Canned Fishery Products, 1943. Sardine canning and reduction plants report season 1943-1944. Circular No. 18, 1944.

Statistical Report on Fresh and Canned Fishery Products, 1944. Sardine canning and reduction plants report season 1944-1945. Circular No. 19, 1945.

Statistical Report on Fresh and Canned Fishery Products, 1945. Sardine canning and reduction plants report season 1945-1946. Circular No. 20, 1946.

TEACHERS' BULLETINS

* No. 1. A Few Reasons for Teaching Bird Study in the Schools. By Gretchen L. Libby. 1912; 4 pp.

* No. 2. Birds as Rodent Destroyers. By Gretchen L. Libby. 1912; 4 pp.

* No. 3. Owls. By Gretchen L. Libby. 1912; 4 pp.

* No. 4. Game Conservation and Its Importance. By Gretchen L. Libby. 1913; 4 pp.

*No. 5. Game Conservation and Its Importance. (Continued from No. 4.) By Gretchen L. Libby. 1913; 4 pp.

No. 6. Bats as Desirable Citizens. By Joseph Grinnell. 1916; 4 pp.

No. 7. The European House Sparrow and Its Control in California. By Harold C. Bryant. 1916; 8 pp., 6 figs.

No. 8. Fish and Game Laws and the Reasons for Them. By Harold C. Bryant. 1926; 7 pp.

* No. 9. Bird Study for California Schools. By Gretchen L. Libby and Harold C. Bryant. 1928; 80 pp., 11 figs.

No. 10. The Owls of California. By Donald D. McLean. 1928; 16 pp., 4 figs.

MISCELLANEOUS BULLETINS

A number of other special bulletins, leaflets and statements have been issued by the commission. Since most of these are out of print no complete listing of them is presented. Those still available for distribution are listed among the reprints and separates in the last section of this compilation.

* Out of print.

CALIFORNIA FISH AND GAME

California Fish and Game is a publication devoted to the conservation of wildlife and published quarterly by the California Fish and Game Commission.

Vol. 1. 1914-1915
* No. 1. October, 1914
No. 2. January, 1915
No. 3. April
* No. 4. July
* No. 5. October

Vol. 2. 1916
* No. 1. January
* No. 2. April
* No. 3. July
* No. 4. October

Vol. 3. 1917
* No. 1. January
No. 2. April
No. 3. July
* No. 4. October

Vol. 4. 1918.
No. 1. January
* No. 2. April (Herring number)
* No. 3 July (Kelp number)
* No. 4. October

Vol. 5. 1919
No. 1. January
No. 2. April
* No. 3. July (Trout number)
No. 4. October

Vol. 6. 1920
* No. 1. January
No. 2. April
* No. 3. July
No. 4. October

Vol. 7. 1921
* No. 1. January (Salmon number)
* No. 2. April (History number)
* No. 3. July (Hawk number)
* No. 4. October (Sardine number)

Vol. 8. 1922
* No. 1. January (Game refuge number)
* No. 2. April (Hatchery number)
No. 3. July
No. 4. October

Vol. 9. 1923
No. 1. January
No. 2. April
No. 3. July
No. 4. October

Vol. 10. 1924
* No. 1. January
No. 2. April
No. 3. July (Klamath conservation number)
No. 4. October

Vol. 11. 1925
No. 1. January
No. 2. April
No. 3. July
No. 4. October

Vol. 12. 1926
No. 1. January
No. 2. April (Striped bass number)
No. 3. July
No. 4. October

Vol. 13. 1927
No. 1. January
No. 2. April (Game propagation number)
No. 3. July
No. 4. October

Vol. 14. 1928
* No. 1. January (Commercial fisheries number)
* No. 2. April (Convention number)
No. 3. July
No. 4. October

Vol. 15. 1929
* No. 1. January
* No. 2. April
* No. 3. July
* No. 4. October

Vol. 16. 1930
* No. 1. January
* No. 2. April
* No. 3. July
* No. 4. October

Vol. 17. 1931
No. 1. January (Spiny-rayed fish number)
* No. 2. April
* No. 3. July
* No. 4. October

Vol. 18. 1932
* No. 1. January
* No. 2. April
* No. 3. July
* No. 4. October

Vol. 19. 1933
* No. 1. January
No. 2. April (Trout number)
* No. 3. July
* No. 4. October

Vol. 20. 1934
No. 1. January
* No. 2. April
* No. 3. July
No. 4. October
* Index to authors and subjects Vols. 1-20, 1914-1934

* Out of print.

Vol. 21. 1935
- No. 1. January (Commercial fisheries number)
- No. 2. April
- No. 3. July
- No. 4. October

Vol. 22. 1936
- No. 1. January (Commercial fisheries number)
- No. 2. April
- * No. 3. July
- * No. 4. October

Vol. 23. 1937
- No. 1. January
- No. 2. April
- No. 3. July
- No. 4. October

Vol. 24. 1938
- No. 1. January
- * No. 2. April
- No. 3. July
- No. 4. October

Vol. 25. 1939
- * No. 1. January
- No. 2. April
- No. 3. July
- No. 4. October

Vol. 26. 1940
- * No. 1. January
- * No. 2. April
- No. 3. July
- No. 4. October

Vol. 27. 1941
- No. 1. January
- No. 2. April
- * No. 3. July
- * No. 4. October

Vol. 28. 1942
- * No. 1. January
- * No. 2. April
- No. 3. July
- No. 4. October

Vol. 29. 1943
- No. 1. January
- No. 2. April
- No. 3. July
- No. 4. October

Vol. 30. 1944
- No. 1. January
- No. 2. April
- No. 3. July
- No. 4. October

Vol. 31. 1945
- No. 1. January
- No. 2. April
- No. 3. July
- No. 4. October

Vol. 32. 1946
- No. 1. January
- No. 2. April
- No. 3. July
- No. 4. October

REPRINTS AND SEPARATES

All reprints and separates listed below are from CALIFORNIA FISH AND GAME, unless otherwise stated, and are still available for distribution.

Kelp and Seaweed

California Seaweeds. By P. Bonnot. Vol. 17, No. 1, January, 1931.
Giant Kelp Utilized at Monterey. By J. B. Phillips. Vol. 18, No. 1, January, 1932.
The Harvesting of Kelp in California. By W. L. Scofield. Vol. 21, No. 1, January, 1935.
The Kelp Resources of Southern California. By J. F. Wohnus. Vol. 28, No. 4, October, 1942.

Mollusks

Devilfish and Squid. By Harold Heath. Vol. 3, No. 3, 1917.
Conservation Laws Provide Ample Protection for Abalones. By N. B. Scofield. Vol. 16, No. 1, January, 1930.
Oyster Culture in California. By H. C. McMillin and P. Bonnot. Vol. 17, No. 3, July, 1931.
Report on the California Oyster Industry for 1936. By P. Bonnot. Vol. 23, No. 2, April, 1937.
Has the Closed Area Increased the Pismo Clam Population? By F. N. Clark and R. S. Croker. Vol. 23, No. 2, April, 1937.
Report on the California Oyster Industry for 1937. By P. Bonnot. Vol. 24, No. 2, April, 1938.
The Pismo Clam in 1938. By P. M. Roedel. Vol. 25, No. 2, April, 1939.
The Edible Bivalves of California. By P. Bonnot. Vol. 26, No. 3, July, 1940.
California Abalones. By P. Bonnot. Vol. 26, No. 3, July, 1940.

* Out of print.

Crustacea

Note on the Habits and Use of the Small Sand Crab *(Emerita analoga)*. By F. W. Weymouth. Vol. 5, No. 4, October, 1919.
Crayfish. By P. Bonnot. Vol. 16, No. 3, July, 1930.
The Market Crab of California and Its Close Relatives. By J. B. Phillips. Vol. 25, No. 1, January, 1939.
The Crab Industry at Eureka. By Leslie E. Lahr. Vol. 25, No. 4, October, 1939.
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THE RANGE OF THE RUFFED GROUSE IN CALIFORNIA

The Ruffed Grouse *(Bonasa umbellus)* has a restricted range in California and does not figure importantly as a game species for this reason and because of its small numbers. Recently a substantial extension of its known range has been revealed through field work conducted in Trinity County. On June 9, 1946, at the southeast base of Hayfork Baldy, 3,600 feet, Trinity County, I came upon a female ruffed grouse which gave evidence through her actions of the presence of young. The young were not found, but when the adult was prepared as a specimen (No. 95519, Mus. Vert. Zool.) it showed clear evidence of having laid and incubated eggs in the course of the spring. The area where the bird was taken was a sloping bench, 600 feet above the canyon bottoms, where the

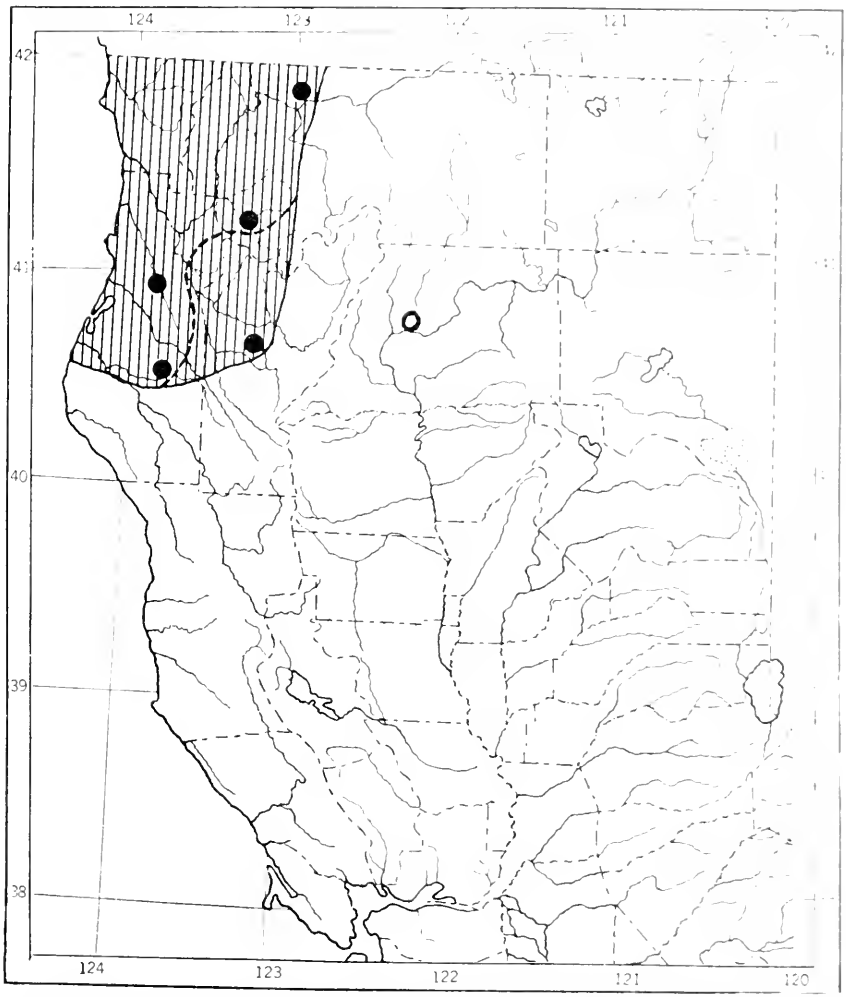

FIGURE 8. Range of Ruffed Grouse in California. Shaded area marks present range; broken line represents margin of range as previously known; circle marks Pleistocene occurrence. Locations of certain interior records are represented by dots.

timber was open and free of brush. The ground was covered with tufts of sparse grass and with leaves. The forest was primarily of Douglas fir, but yellow pines were also common. There were scattered black oaks, madrones, and clumps of young Douglas fir two to six feet in height.

Heretofore, the ruffed grouse has not been reported from Trinity County. The nearest points of record have been the vicinity of Bridgeville, Humboldt County, 35 miles to the west, and the Salmon River area, Siskiyou County, a similar distance north (Grinnell and Miller, Pac. Coast Avif. No. 27, 1944:116). More important than the air-line distances involved are the intervening mountain barriers that alter the climate southeastwardly by intercepting much of the coastal fog and rain. The conditions at Hayfork Baldy, although not typical of the humid coastal environment where this grouse normally occurs in California, are not much different from those in southern Oregon on the slopes of the Cascade Mountains where it has been found. The grouse from Trinity County is typical of the Oregon race, *B. u. sabini,* as are others from coastal California.

It is worth recalling that in Pleistocene time the ruffed grouse ranged southeastwardly in California even farther, to Potter Cave, near Baird, on the lower McCloud River, Shasta County (L. Miller, Univ. Calif. Publ. Bull. Dept. Geol. Sci., 6, 1911:397).

Hayfork Baldy and vicinity are included in State Game Refuge 1D, and our work there was made possible through the cooperation and with the permission of the Division of Fish and Game. It is fortunate that the refuge guards the present southeastern outpost of the ruffed grouse in the state. The refuge may well function to build up the number of grouse and perhaps serve as a center for local dispersal.—*Alden H. Miller, Museum of Vertebrate Zoology, University of California, Berkeley, August, 1946.*

FURTHER OBSERVATIONS ON DEER FOOT WORM INFECTION

In a recent article (California Fish and Game, Vol. 32, No. 4, p. 182) Herman and Bischoff reviewed current knowledge of the occurrence of the foot worm *(Onchocercus cervipedis)* in California deer. It was reported that only the feet were involved in the infected animals which were examined.

On September 25, 1946, Wardens Walter L. Gray and L. L. Werden of Eureka, California, examined an old four point buck Columbian blacktail deer *(Odocoileus hemionus columbianus),* killed on South Fork Mountain in Humboldt County, California, heavily infected with foot worms. These wardens reported that the worms occurred over the entire animal and not just on the feet. They also reported that besides the usual site of infection in the region of the hock joints, the worms were very numerous on the back and were even found under the skin of the neck and about the ears. In spite of this heavy infection, the wardens felt the animal was in fair condition when compared with other deer in the area. Small hemorrhages occurred in conjunction with these worms but a detailed examination was not made to determine whether or not this condition was actually connected with the parasites. Another deer shot at the same time and place had the worms only in the feet.—*Carlton M. Herman, Bureau of Game Conservation, California Division of Fish and Game, December, 1946.*

IN MEMORIAM

JOHN O'CONNELL

Fish and Game Patrol Captain John O'Connell died at Franklin Hospital, San Francisco, December 5, 1946, following a major operation. Captain O'Connell was born at Benicia on October 2, 1882. In his youth he spent several years farming for himself and joined the Vallejo City Police force in 1908 working there until he was appointed a Fish and Game Warden in the fall of 1917.

In June, 1927, he was promoted Captain in Charge of the Stockton District and in the same month was seriously wounded while arresting a game law violator near Lodi. He made a complete recovery and remained in charge of the Stockton District until his death.

For the nearly 30 years that he was with us Captain O'Connell was a steady, conscientious worker, a kindly and thoughtful supervisor of the men in his area. He leaves a widow and daughter to whom we express our deepest sympathy.—*E. L. Macaulay, Chief, Bureau of Patrol, California Division of Fish and Game, January 15, 1947.*

REPORTS

FISH CASES

July, August, September, 1946

Offense	Number arrests	Fines	Jail sentences (days)
Abalones: taking abalone from shell below high water, undersize, failure to show, overlimit, no license, using license of another	165	$5,285 00	
Angling: refuse to show fish on demand, failure show license, closed stream, using set lines, no license, spearing, gaff 300′ of stream, sunfish closed season fishing near dam, other than angling, using non-native fish for bait, using net over 6″ in length to take minnows	159	2,710 00	
Bass: no license, night fishing, using more than one line, selling and buying striped bass	127	4,510 00	
Catfish: closed season, undersize overlimit, no license, selling undersized	3	500 00	
Chumming	6	250 00	
Clams: undersized, overlimit, closed season, out of shell	53	1,520 00	
Commercial: netting salmon on Sunday, illegal diving, using drag net closed area, failure keep record, no shell fish dealer license, operating lampara net closed area, no license, failure show permit number on boat sides, trawl net closed area	55	4,555 00	
Crabs: undersized, overlimit	2	75 00	
Lobsters: failure show license, overlimit undersize, closed season, traps closed district, selling oversize	10	840 00	
Pollution:	3	400 00	
Salmon: spawning bed, undersize, no license, closed season	13	440 00	
Trout: closed season, using more one line closed stream, overlimit, selling untagged domesticate trout	60	1,895 00	
Totals	656	$22,980 00	

GAME CASES

July, August, September, 1946

Offense	Number arrests	Fines	Jail sentences (days)
Deer: closed season, spike buck, at night, spotlighting, failure tag properly	200	26,730 00	196
Deer meat: closed season, illegal possession, unmarked	28	3,205 00	125
Doves: closed season, overlimit, failure show license	92	2,365 00	
Ducks: closed season, unplugged gun	14	650 00	
Hunting: firearms in refuge, at night, no license, shooting from highway, on posted land resist arrest	92	1,748 00	
Nongame bird: no permit	9	296 00	2
Pheasant: shooting from vehicle, hen, closed season, no license	77	7,395 00	
Quail: closed season, overlimit	19	850 00	
Rabbit: closed season, refuge no license	32	893 00	
Pigeons: closed season, overlimit	1	25 00	
Totals	564	$45,157 00	323

SEIZURES OF FISH AND GAME

July, August, September, 1946

Fish:

Abalone	103
Bass, black	50
Bass, striped	2
Barracuda	122
Catfish	225
Clams	741
Crabs	8
Crappie	1
Halibut	1
Kelp and rock bass	47
Lobsters	11
Lobster, traps	4
Mackerel	40
Octopus	9
Salmon	2
Sturgeon	1
Sunfish	145
Trout	520

Game:

Bear		1
Deer		30
Deer meat	160	300
Doves		37
Ducks		18
Hamsters		13
Pheasants		72
Quail		15
Rabbits		28
Sagehens		4
Squirrels		2

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(Continued from inside front cover)

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